



GlobalHAB - the International SCOR-IOC Science Program on Harmful Algal Blooms

Program Activities 2017-2018 and Plans for the 2018-2019 period

GlobalHAB Scientific Steering Committee members

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Michele Burford, Griffith University, Australia
Christopher J. Gobler, Stony Brook University, USA
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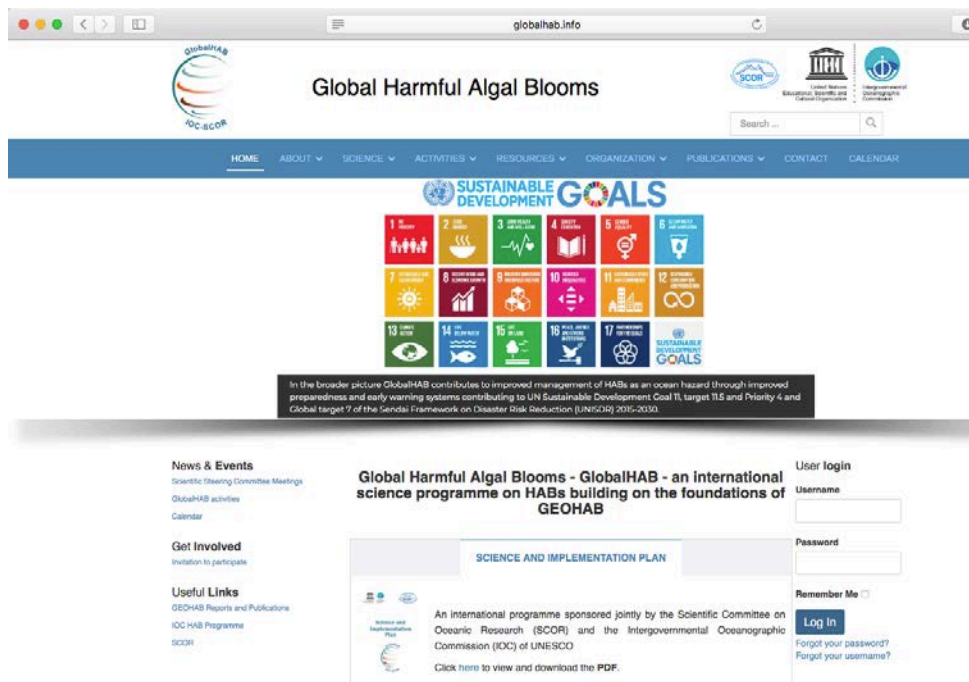
Henrik Enevoldsen, IOC UNESCO/ University of Copenhagen, Denmark
Ed Urban, Scientific Committee on Oceanic Research, USA

The GlobalHAB Scientific Steering Committee (SSC) acknowledges the financial and logistic support received from SCOR during this 2015-2018 period. The funds have made possible the final elaboration of the GlobalHAB Science and Implementation Plan, representation of the program at international meetings and publications completing the work of the GEOHAB program. SCOR funds are also contributing to the implementation of some initiatives prioritized by GlobalHAB at short-term. The GlobalHAB activity is described next.

1. Finalization of the GlobalHAB Science and Implementation Plan

The *GlobalHAB Science and Implementation Plan* was initiated by the GlobalHAB SSC during its first meeting, held in Oban, UK (March 2016). The first draft version of the Plan was presented at the SCOR Annual Meeting in Sopot, Poland (September 2016) by Elisa Berdalet and at the 17th International Conference on Harmful Algae (ICHA) (<http://icha2016.com/about/>) attended also by most SSC members. At the ICHA meeting the international community was invited to provide inputs to the Science and Implementation Plan. In January 2017, the complete draft of the Plan was evaluated by 9 external reviewers.

The revised version of the plan was the focus of the second meeting of the SSC, held at the Stazione Zoologica di Napoli (SZN) in Naples (Italy) on March 28-30, 2017. In November 2017, the final Plan was edited and made free available at the GlobalHAB webpage (www.globalhab.info), which was active in January 2018.



Home page of the GlobalHAB website. This image illustrates in particular that, in the broader picture, GlobalHAB contributes to improved management of HABs as an ocean hazard through improved preparedness and early warning systems thus contributing to UN Sustainable Development Goal 11, target 11.5 and Priority 4 and to Global target 7 of the Sendai Framework on Disaster Risk Reduction (UNISDR) 2015-2020.

2. Meetings of the GlobalHAB SSC members



GlobalHAB SSC members at the entrance of the LOV, April 2018. Participants (left to right): Henrik Enevoldsen, Ed Urban, Bengt Karlson, Vera Trainer, Chris Gobler, Elisa Berdalet, Raphe Kudela, Marina Montresor, Po Teen Lim, Neil Banas, and Kedong Yin.

The GlobalHAB SSC held its third meeting at the Laboratoire d'Océanographie de Villefranche (LOV) in Villefranche-sur-mer (France) on April 10 and 11, 2018 hosted by Dr. Rodolphe Lemée. His students, Anne-Sophie Marron, and Kévin Drouet offered a brief presentation of their PhD thesis and a tour through the LOV facilities was conducted with Dr. Lars Stemman. Dr. Lemée also presented the artificial substrate method for sampling benthic microalgae, which he had also introduced during the concurrent Regional Workshop on Monitoring and Management Strategies for Benthic HABs in Monaco, April 9-12, 2018. GlobalHAB acknowledges the LOV for its kind support.

The meeting addressed the following items:

1) Revision of the Implementation Activities identified in the former SSC meeting in Naples to address the objectives of the 12 GlobalHAB Themes and planned for the 2017-2019 period. Before the meeting each SSC member was invited to elaborate a presentation addressing *what had been done, what will be done, what are the needs (funds, maturity of the action) for implementation actions, limitations, change of plans, etc.*

2) Information on HAB related activities fostered by IOC/UNESCO and other entities (ISSHA, IPHAB, ICES, PICES, UNEP).

3) Communication strategies (Endorsement procedure, website maintenance), budget, SSC membership renovation system.

The main conducted, ongoing and planned activities corresponding to each GlobalHAB Theme, and other key issues are presented in the next sections.

3. Implementation activities in the 2017-2019 period

Theme 1. Biogeography and Biodiversity. Responsible: Marina Montresor

Activity 1.1. In progress. Review paper on the taxonomy of selected harmful taxa and links with toxin production. Leader: **M. Montresor**. ICES is also thinking of an effort on this topic and HAB biogeography is a topic within ISSHA. Preliminary contacts have been made with E. Bresnan (ICES), U. Tillmann, N. Lundholm, S. Fraga, A. Kremp, D. Sarno, A. Zingone. Contents include cryptic species and pseudo-cryptic species, morphology and ultrastructure, molecular data, physiology, ecology and toxicity.

Activity 1.2. October 2018. HABs biogeography session within the 18th ICHA. **E. Berdalet** contacted the ICHA organizers, biogeography is included in two sessions. An oral communication about GlobalHAB is scheduled (see section 4 in this Report).

Activity 1.3. November 2018. Workshop on dinoflagellates taxonomy. **M. Montresor** and **E. Berdalet** have fostered a workshop on this topic co-organized by EukRef of UniEuk (<http://www.unieuk.org>). *EukRef* is a standardized, open-source bioinformatics pipeline that allows taxonomic curation of publicly available phylogenetic marker sequences (starting with 18S rDNA), generating homogeneous sets of curated, aligned sequences and phylogenetic trees. *EukRef* is one of the modules of *UniEuk* (www.unieuk.org), an open, community-based and expert-driven international initiative to build a flexible, adaptive universal taxonomic framework for eukaryotes, focused primarily on protists. The workshop will be held in Roscoff, (France) on 5-9 Nov 2018. Main organizers are Cedric Berney (taxonomy coordinator), Raffaele Siano, Laure Guillou, Javier del Campo, Christian Quast, Pelin Yilmaz and Colomban de Vargas.

Activity 1.4. - In progress. GlobalHAB Status Report coordinated by **Henrik Enevoldsen**.

In order to develop and launch the first Global HAB Status Report a network of data providers for OBIS-HAB and HAEDAT has been established/reconfirmed and an Editorial Team for the First Global HAB Status Report has been established together with a data flow structure.

The network of data providers in ICES and PICES regions for OBIS-HAB and HAEDAT has been expanded in cooperation with IAEA in the South Pacific, SE Asia, the Caribbean and Africa. One joint WS was held in South Pacific, one in the Caribbean, one for Africa. Additionally, a training workshop for data editors across regions was held in Ostend 25-28 September 2017. Reviewing the literature and other sources for HAB species occurrences for entry into OBIS and compilation of data on HAB events for HAEDAT is ongoing. A data compilation template for HAB data in OBIS has been developed and reviewed and is in use (https://github.com/iobis/habtemplate/blob/master/habtemplate_a_v4.xlsx). This will allow to complement, and add value to, data already in OBIS with baseline observations recorded in the literature.

Establishment of a data flow with global coverage has taken longer than expected, but major progress has been achieved and all key regions are now covered with only South East Asia pending full coverage. This is except regions/countries which are already regularly submitting HAB event data to HAEDAT (North Atlantic, North Pacific, China etc.).

During second half of 2016 till end 2017 focus continued to be on data compilation and upgrades/adjustments to the data systems (HAEDAT as well as the OBIS-HAB data entry template). Additionally, the Editorial Team for the GHSR has developed the outline of the GHSR and chapters are drafted. Agreement has been reached with the Elsevier Journal Harmful Algae for a special issue in 2019 with regional summaries on HAB based on OBIS, HAEDAT and the literature.

The planned online tools to create information products have yet to be developed and will focus on creating the products for the GHSR. Currently, a new data portal for HAEDAT is in development (<http://dev.iobis.org/haedat/>).

A first Editors-in-Chief (3) meeting for the Global HAB Status Report was held 23-24 May 2015 in Sweden. An outline of the Global HAB Status Report was developed and a detailed timeline for the drafting was defined. The Editorial Team held its second meeting on 29-31 March 2016 in Monaco co-funded by the IAEA as foreseen in the project document. The Editorial Team then held its third meeting on 27 September in Ostend, Belgium, during the above-mentioned data training workshop. An updated work plan and a revised outline of the Global HAB Status Report with chapters and authors was prepared and the draft chapter outlines were reviewed.

The GHSR is foreseen to be complete by end 2018 and to be launched early 2019.

Theme 2. Adaptive Strategies. Responsible: Michele Burford.

There was nothing to be reported on this theme, which is crosscutting other Themes. The SSC will follow on the content and implementation of this Theme.

Theme 3. Toxins. Responsible: Po Teen Lim.

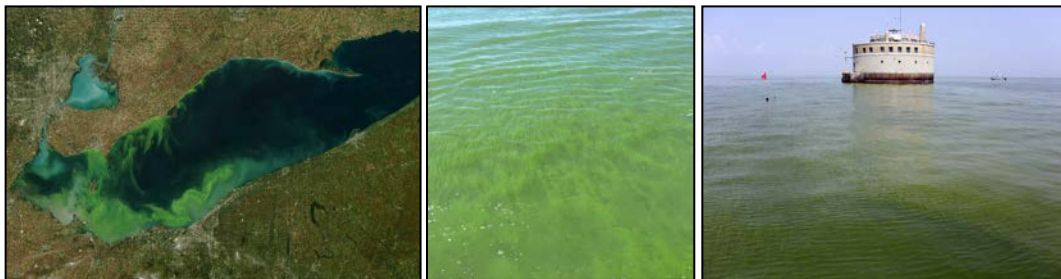
Activity 3.1. In progress. Develop plans for fish-killing HABs workshop (with Allan Cembella and Per Juel Hansen, in collaboration with ICES). There has been no progress along this year yet. The activity is followed by **Po Teen Lim**. See also *Activity 7.2*.

Activity 3.2. In progress. Develop plans for a Workshop and Summer school on analysis and interpretation of genetic data relevant to HAB toxicity. The activity is followed by **Po Teen Lim**, who is hosting a regional workshop on toxins for Southeast Asia, as well as the Xiamen Marine Environment Meeting.

Theme 4. Nutrients. Responsible: Kedong Yin.

There was nothing to be reported on this theme. **Kedong Yin** and the SSC will follow on the content and implementation of this Theme.

Theme 5. Freshwater HABs and CyanoHABs. Responsible: Chris Gobler and Michele Burford, that have been working on three main activities.



Activity 5.1. In progress. Manual for water managers on mitigation of cyanobacterial HABs. The goal is an aesthetically appealing, easy to understand document for drinking and recreational water managers on managing cyanobacterial HABs available in print and on web.

- **Outline:**
 - Background on cyanoHABs
 - Risks and standards for drinking water and recreational water
 - Options for mitigating cyanoHABs
 - Watershed management
 - Whole ecosystem management
 - Drinking water treatment
 - Recreational water treatment
- **Materials:** Existing information from peer-reviewed literature and reputable governmental documents
- **Status:**
 - A summary document has been circulated to GlobalHAB steering committee. It can be endorsed.
 - Document has been outlined and partly written; will be circulated to scientific community as well as managers for review.

- **Needs:** Logistical and financial support is needed for document design and lay-out perhaps in a manner to the GEOHAB policy maker document.

Activity 5.2. In progress: Webinar series on cyanoHABs for water managers, informational, one-hour duration, on cyanoHABs with a focus on management.

- **Topics:**
 - Background on cyanoHABs
 - CyanoHABs ecology
 - Risks and standards for drinking water and recreational water
 - Monitoring techniques, cells and biomass microscopic and molecular methods
 - Monitoring techniques, toxin analysis
 - Mitigating cyanoHABs: Watershed management
 - Mitigating cyanoHABs: In water treatment
 - Mitigating cyanoHABs: Drinking water treatment
 - Webinars could be housed on GlobalHAB YouTube channel with links on GlobalHAB web site

The webinar series needs financial support the set-up logistics.

Activity 5.3. In progress: Global maps of cyanoHABs. Michele and Chris are working on several maps:

- Map of key problem cyanobacterial blooms and toxins globally to be placed on GlobalHAB website.
- Maps for *Microcystis* and *Cylindrospermopsis (Raphidopsis)*: they are complete.
- Desire to make maps interactive with click and hover options for each country/incident with references, downloadable information, references.

Logistical and financial support is needed for to gather information for other cyanoHAB maps, to make them, and make them interactive with downloadable data and information. The maps could be added or linked to IOC-UNESCO Taxonomic Reference List of Harmful Microalgae.

Theme 6. BHABs. Responsible: Elisa Berdalet

Activity 6.1. In progress. GlobalHAB is collaborating in the coordination and implementation of the multiagency "IOC - IAEA - FAO - WHO Global Ciguatera Strategy". In particular, it participated in the workshop held during the Monaco's Ocean Week 9-12 April 2018, at the Oceanographic Museum of Monaco. The aims of the Workshop was to identify the main gaps that limit monitoring of BHAB species and their toxins in the most affected areas and define the best approaches to prevent and manage their impacts.

The workshop was structured on three major topics:

* Methods for Sampling benthic species, and to design an intercomparison experiment involving participants from about 30 countries.

- * Methods for monitoring toxins, with cost effective and reliable methods in the affected areas
- * Epidemiology studies on BHABs health impacts



Other activities that were planned at the launch of GlobalHAB are expected to be implemented in 2019-2021 period. These include a PCR/qPCR *Gambierdiscus* identification workshop, the 2nd International Conference on *Ostreopsis* Development, and a meeting on BHABs, health and economy in coordination with Themes 10 and 11.

Theme 7. Aquaculture. Responsible: Lincoln Mackenzie.

Activity 7.1. In progress, first results expected August 2018. **Lincoln** informed about the GlobalHAB endorsed project "International Collaborative Study for the Validation of a HILIC-MS/MS Method for Analysis of Paralytic Shellfish Toxins and Tetrodotoxin in Live Bivalve Molluscs". The workshop is leaded by Tim Harwood (Cawthron Institute, Nelson, New Zealand) and Andrew Turner (Centre for Environment Fisheries and Aquaculture Science -Cefas-, Weymouth, United Kingdom). Twenty-four labs are involved in an inter-laboratory validation study and they have recruited three study advisors: Paul McNabb (NZ), Ana Gago Martinez (EURLMB Spain) and Jim Hungerford (FDA USA). The results will be available around the end of August 2018. GlobalHAB could help broadcast the results of the study. Lincoln suggested that GlobalHAB could help support a follow-up workshop. Bengt commented that this looks like a good effort. Chromatography columns were donated by a company.

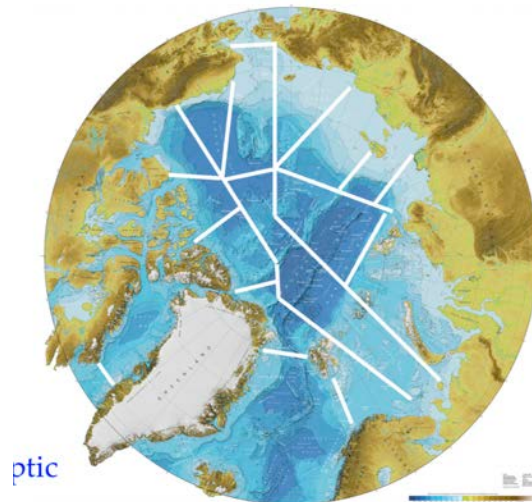
Activity 7.2. February 2018. Consider presenting a proposal for a SCOR WG on HABs and Aquaculture.

Activity 7.3. In process, with certain changes. Collaborate with the responsables of Topic 3, Toxins, in order to implement the Workshop on Fish-killing algae.

Theme 8. Comparative ecosystems. Responsible: Bengt Karlson.

Activity 8.1. To be explored. The IOC Trends PO activity is related to this Theme 8 and it is also linked to Theme 1. Comparative work on different environments and harmful events have also been conducted by PICES and NOAA. Raphe Kudela suggested that there could be a group of PICES, ICES, TrendsPO, and GlobalHAB to discuss time series of HABs and climate change.

Activity 8.2. To be explored. Bengt suggested to write a proposal to add HABs on the Synoptic Arctic Survey that will be conducted on 2020 or 2021, with the participation of at least 10 countries.



Theme 9 and Cross cutting activities. Responsible: Raphael Kudela.

Activity 9.1. To be explored. GlobalHAB identified the potential links between ocean deoxygenation and HABs and there was an initial wish to interaction with IOC GO2NE (Global Ocean Oxygen Network, <http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-and-programmes/ocean-sciences/global-ocean-oxygen-network/>). The GlobalHAB SSC will work in contact with Grant Pitcher to identify potential research on this topic.

Activity 9.2. In progress. GOOS Panel on Biology and Ecosystems. – The Essential Ocean Variable (EOV) for Phytoplankton Biomass and Diversity is [online](#) and it includes HABs. The information has been summarized in the paper "Essential ocean variables for global sustained observations of biodiversity and ecosystem

changes", by Miloslawick et al. (2018), Global Change Biology, DOI: 10.1111/gcb.14108, coauthored by **Raphe Kudela**. A workshop will be conducted in June 2018 to try to begin implementing the EOY for phytoplankton and zooplankton measuring everything as recommended in the EOY, including the HAB component (genus and species information), perhaps on a GO-SHIP cruise.

Activity 9.3. **Raphe Kudela** participated in the [Alliance for Coastal Technologies](#) workshop in Jan 2017 on detection of HABs (see [report](#)). A second workshop and technology demonstration on toxin detection will be conducted soon. This organization is supported by U.S. companies, but is open to any vendor. There are a series of field sites, including Monterey, Lake Erie, and Long Island.

Activity 9.4. OCCG/GEOHAB Monograph. This activity is still continuing. A former student of Stuart Bernard has taken over production and is moving forward. The monograph should be finished soon, in 2018.

Theme 10. Health. Responsible: Elisa Berdalet

Activity 10.1. *April 2018.* Endorse and participate in the implementation of the coordinated IOC-IAEA-FAO-WHO "Global Ciguatera Strategy" and participate in the Regional Workshop on Monitoring and Management Strategies for Benthic HABs, Monaco, 9-12 April, 2018. This activity corresponds to Activity 6.1, here focused in the health aspects. **E. Berdalet** contributed to the organization of the questionnaires designed to better assess the existing capacity in benthic HABs management in relation to human poisonings surveillance programs, regulations, outreach campaigns, investigation procedures in case of epidemics, etc. The objective was, through relevant case studies, to discuss, during the workshop, about existing programs, good practices, but also identify gaps, needs and propose adapted solutions. The workshop was aimed to provide guidance for improved mitigation of HAB health effects on ciguatera and prevention of respiratory impacts related to *Ostreopsis* blooms. Accommodation of E. Berdalet was funded by Accord RAMOGE that co-sponsored the workshop with IAEA that covered invitation of ca. 30 participants, logistics, etc.

Activity 10.2. *March 2018 to October 2019.* **E. Berdalet** represented GlobalHAB at the CLEFSA workshop: Emerging threats on human health in Europe due to climate change. CLEFSA is a project of the European Food Safety Agency (EFSA), that explores the risks of food intoxication in future climate change scenarios. CLEFSA included aquatic biotoxins in the European landscape. The event was held in Parma at the EFSA headquarters in March 2018. E. Berdalet is collaborating in the elaboration of Reports and documents through online communication and particular meetings.



Activity 10.3. April 2018. **Elisa Berdalet** was invited as External Expert in the SOPHIE project, a Coordination and Support Action (CSA) of the European Commission aimed to develop a programme on Oceans and Human Health in Europe. Elisa represents GlobalHAB and the HABs and Health Theme. A first workshop was held in Dublin, April 24-25, 2018, funded by SOPHIE.

Theme 11. Economy. Responsible: Vera Trainer and Keith Davidson.

Vera reviewed U.S. National HAB activities to estimate the economic cost of HABs and the existence of some fundamental problems with such a national estimate based on minimal data.

Activity 11.1. To be explored. **Vera Trainer** proposed a workshop on the economics of HABs at the 2017 annual PICES meeting and this seems like a good area of cooperation between GlobalHAB and PICES.

The goals would be to:

- Determine effective approaches for HAB economics research;
- Set priorities for HAB economics research based on highly impacted regional sectors;
- Develop partnerships between economists and HAB scientists; and
- Attract additional (resource) economists to the field.

Vera will work on the organization of the proposal including identification of the steering committee; time, duration and location; funding; size of workshop; contributors; structure (example studies, specific questions to be addressed). Victoria, Canada: Oct 2018 (prior to annual PICES meeting) OR Seattle, WA. There is a common interest on determining the socioeconomic impacts of HABs by PICES, NOAA (they have expertise also), Insurance Industry, GlobalHAB, and some European efforts (for instance, conducted under the CoCliME project).

The results of the workshop could be published online, as part of the "Good practices manual".

Theme 12. Climate Change. Responsible: Neil Banas.

Activity 12.1. Special issue on the journal Harmful Algae focused on "Climate Change and HABs". Responsible: Chris Gobler. The editors of the special issue are Chris Gobler and Mark Wells. 14 articles have been solicited, potential authorship is indicated in italics:

1. The Future of HAB Science: Directions and Challenges. *HAB-Climate Change Symposium Organizers and Breakout Discussion Leads.*
2. Projected Latitudinal Changes in Environmental Conditions Influencing HABs. *Fei Chai, Ernrique Curchitser (Temperate latitude), Phil Boyd lead (High latitude), Low latitude (TBD).*
3. Modelling HABs in a changing climate. *Kevin Flynn, Inga Hense, Neil Banas, Dennis McGillicuddy, Stephanie Dutkiewicz.*
4. Theoretical and Observed Effects of Dynamic CO₂ levels on HABs. *John Raven, Per Juel Hansen, John Bearall, Chris Gobler.*
5. The Use ofOMIC Tools in HAB Research. *Authorship: Sonya Dhyrman, Student, Steve Wilhelm.*
6. Cyanobacterial HABs and Climate Change in Freshwater, Brackish and Marine Waters. *Michele Burford, Hans Pearl, Angela Wulff, Jef Huisman, Petra Visser.*
7. Toxic pelagic HABs and Climate Change. *Gustaaf Hallegraeff, Vera Trainer, Don Anderson.*
8. Benthic HABs and Climate change. *Pat Tester, Elisa Berdalet, Wayne Litaker.*
9. Fish-killing HAB and Climate change. *Charles Trick, Gustaaf Hallegraeff, Alan Cembella.*
10. High biomass HAB and Climate change. *Bill Sunda, Grant Pitcher, Gobler*
11. Future observing systems. *Bengt Karlson, Raphe Kudela, Stewart Benard*
12. HABs as a co-stressor in a changing world. *Chris Gobler, Sandra Shumway, Hannes Baumann*
13. Zooplankton grazing and HABs. *Hans Dam, Susan Menden-Duerer, Diane Stoeker, Matt Johnson*

Submission deadline of July 1st and GlobalHAB will support some open access, likely to the first article (to be decided).

The main key messages from the special issue will be used to elaborate a Scientific Summary for Policy Makers (SSPM) on HABs and Climate Change. It will be started on January 2019 to be presented at the 2019 IPHAB meeting in Paris. The SSPM could be linked to the two IPCC 1.5C special reports that are coming out this year and next year.

Activity 12.2. Best-practices Manual. Information from Marina Montresor.

The editorial team, constituted by Mark Wells (chair), Michele Burford, Anke Kremp, Marina Montresor, Grant Pitcher and Gires Usup met at the Stazione Zoologica di Napoli (Feb 26th - Mar 1, 2018) to work on the "Best Practice Guidelines for the Study of HABs and Climate Change". The outline of the chapters was defined (each chapter involves members of the editorial board and a lead external author) and the guideline for the authors was prepared.



The editorial board of the "Best Practice Guidelines for the Study of HABs and Climate Change" in their meeting at the SZN.

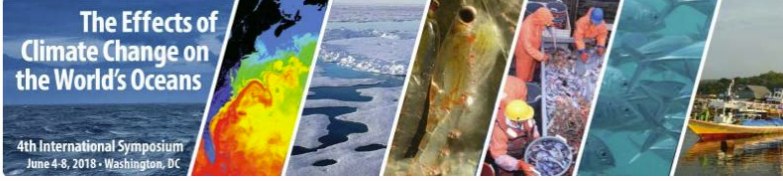
The tentative timeline of the Manual is

- April 2018: contact the lead authors, define the other authors
- June 2018: The outline of the chapters is submitted to the Editorial Board
- November 2018: Draft chapters are submitted to the Editorial Board, sent out for peer review
- Feb/March, 2019: Tentative plans for the Editorial Board to meet with the lead authors to discuss the reviews — decide on the necessary revisions.
- Summer, 2019: Release the proposed Best Practice Guidelines for community comments—via website—for 3 months
- Fall, 2019: Publish the final version of the Best Practice Guidelines

The initiative of the Best Practices Manual for HAB and Climate Change is in line with the activities of SCOR WG149. This group is going to publish soon in the journal Global Change Biology the paper Boyd, P. W., Collins, S., Dupont, S., Fabricius, K., Gattuso, J.-P., Havenhand, J., Hutchins, D. A., Riebesell, U., Rintoul, M. S., Vichi, M., Biswas, H., Ciotti, A., Gao, K., Gehlen, M., Hurd, C. L., Kurihara, H.,

McGraw, C. M., Navarro, J., Nilsson, G. E., Passow, U. & Pörtner, H.-O. (2018). Experimental strategies to assess the biological ramifications of multiple drivers of global ocean change – a review.

Activity 12.3. June 2018. Symposium on Effects of Climate Change on World's Ocean. A session on HABs chaired by E. Berdalet and K. Yin was organized in this symposium: S17. Effects of climate change on ocean ecosystem health: Projecting occurrences of harmful algal blooms and disease outbreaks and assessment of the risk to ecosystem functioning, aquaculture, fisheries and human health (<https://meetings.pices.int/meetings/international/2018/climate-change/program#S1>). Raphe Kudela, Eileen Bresnan and Elisa Berdalet presented three oral communications and participated in the joint discussion of the session. GlobalHAB and IOC/UNESCO provided funds to cover the representation of GlobalHAB at the event.



The Effects of Climate Change on the World's Oceans
4th International Symposium
June 4-8, 2018 - Washington, DC

S17: Effects of climate change on ocean ecosystem health: Projecting occurrences of harmful algal blooms and disease outbreaks and assessment of the risk to ecosystem functioning, aquaculture, fisheries and human health

Convenors:

Elisa Berdalet (Corresponding)
(Institut de Ciències del Mar -CSIC-, Barcelona, Spain)

Ryan Carnegie
(Department of Aquatic Health Sciences, Virginia Institute of Marine Science, College of William & Mary, VA, USA)

Alexandra Campbell
(Faculty of Science, Health, Education and Engineering, University of the Sunshine Coast, Australia)

Kedong Yin
(School of Marine Sciences, Sun Yat-Sen (Zhongshan) University, Guangzhou, China)

Plenary Speaker:
[Iddya Karunasagar](#) (Nitte University, Mangalore, India)

Invited Speaker:
[Xuelei Zhang](#) (First Institute of Oceanography (FIO), State Oceanic Administration, China)

Activity 12.4: Potential future activity. **Neil Banas** presented some possible workshops:

* *“Forecasting HABs: Best practices and emerging techniques”*

Goals:

- Share best practices and emerging techniques
- Improve communication between stakeholders and scientists, in particular educating scientists on what “decision support” actually means

The budget for 20 people (including teachers) and 2 days duration would be £25K (approx). Some Scottish funding (£5-15K) would be available, from the SU2P Partnership (with California universities and industry).

* *“Understanding and predicting climate impacts on HABs”*

Goals:

- A strategy for answering the WoO question (Are windows of opportunity (WoO) for HABs expanding or merely shifting?)
- Designs for biological models for coupling to climate projections (How do we incorporate biological adaptive capacity into long-term projections?)
- Scoping of new research proposals + smaller-scale meta-analysis projects

The budget for 12 people and 3 days duration would be ≈ £18K.

The organization of the workshops will be followed on along this 2018.

New topic: *Sargassum* Blooms

The GlobalHAB Science and Implementation Plan noted that new emerging HAB related issues could be incorporated to the program after its launch. This was the case of the blooms of green macroalgae and *Sargassum*. Elisa Berdalet and Henrik Enevoldsen have been in touch with Brian LaPointe about this topic since 2016. GESAMP has done a scoping paper on *Sargassum*, but it is not clear whether GESAMP will do a follow-up activity. GlobalHAB SSC will work during the coming months to clarify the organization of this theme.

Information from the representatives of other entities (ISSHA, IPHAB, ICES, UNEP, PICES)

ICES Harmful Algal Bloom Dynamics Working Group: Henrik Enevoldsen presented slides from **Eileen Bresnan**. Anke Kremp has been involved from this WG as a member of editorial board of the Best Practices Manual to study the effects of climate change on HABs. The EU Marine Strategy Framework Directive (MSFD) has been updated and now includes pelagic habitat. It includes HABs, mostly in terms of high-biomass blooms. ICES Science Committee (SCICOM) has developed a suite of priorities particularly linked to GlobalHAB, such, e.g. "Food from sea", "Observation and exploration" or "Sea and Society". ICES has established an "Aquaculture Steering Group". SCICOM is also beginning to assign ToRs assessing genomic methodologies to different WGs.

ISSHA: Vera provided an update about the Nantes meeting in October 2018. There will be a networking session at which GlobalHAB will participate. They are planning a student networking event, perhaps student speed networking. ISSHA is updating its Website.

PICES: one of PICES' major involvements is with HAEDAT, and the economics workshop could be a major connection. Douding Lu is a new co-chair of the PICES Section on Ecology of Harmful Algal Blooms in the North Pacific and is still looking for an eastern Pacific representative for the HAB Section.

UN Environment Program (UNEP): Elisa will elaborate an article about GlobalHAB as requested by Christopher Cox. Henrik could go back to UNEP regarding funding for a *Sargassum* open science meeting, if GlobalHAB develops a plan for a meeting.

4. Representation of the program at international events.

Information about GlobalHAB has been or will be provided at the following events:

- The Regional Workshop on Monitoring and Management Strategies for Benthic HABs in Monaco, April 2018. E. Berdalet and H. Enevoldsen, representing the GlobalHAB SSC presented the oral communication "The IOC-UNESCO and SCOR programme GlobalHAB: International Coordination to Advance in the Understanding and Management of Benthic Harmful Algal Blooms Impacts".

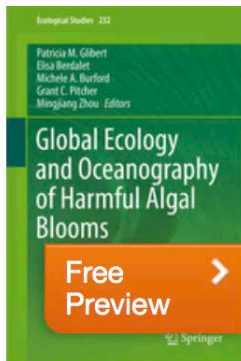
- The Symposium on Effects of Climate Change on World's Ocean, Washington, DC (US), June 2018. A session (S17) on HABs chaired by E. Berdalet and K. Yin was organized in this symposium. Raphe Kudela presented GlobalHAB with a special emphasis on the research priorities on HABs and Climate Change. See [Activity 12.3](#).

- The International Conference on Harmful Algae, Nantes (France), October 2018. Progress on the GlobalHAB program will be presented in an oral presentation (*ICHA2018/616: "GlobalHAB (IOC-UNESCO and SCOR): International coordination for sound knowledge of HABs to manage their impacts"*), coauthored by the whole GlobalHAB SSC) at the Session "Networking activities around HABs: GlobalHAB, Global HAB Status report, ICES-WGs and other initiatives" chaired by E. Berdalet, A. Zingone and P. Hess. It is expected a publication in the *Proceedings*. See [Activity 1.2](#).

5. GEOHAB Synthesis Products

At the official end of GEOHAB, some synthesis products were still in progress and GlobalHAB has taken responsibility to see them completed. On June 2018, the book published by Springer, under their Ecological Studies series was published. The editors are Pat Glibert, Elisa Berdalet, Michele Burford, Grant Pitcher and Mingjiang Zhou.

Ecological Studies



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Global Ecology and Oceanography of Harmful Algal Blooms

Editors: **Glibert, P.M., Berdalet, E., Burford, M.A., Pitcher, G.C., Zhou, M.** (Eds.)

This volume on the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) is aimed at synthesizing the broad range of research and activities that took place during the nearly 2 decades of the international programme bearing this acronym. The central challenge for GEOHAB was to “understand the critical features and mechanisms underlying the population dynamics of HAB species in a variety of oceanographic regimes.” GEOHAB fostered research that was multi-faceted, multi-disciplinary, international and within an oceanographic context. With contributions from 69 authors from all over the world, this book reflects the global reach of the GEOHAB Programme. This volume aims to capture the key focus areas of research under the GEOHAB umbrella. It introduces readers to the overarching framework of GEOHAB, factors contributing to the global expansion of HABs, the complexities of HABs in different habitats, and the forward-looking issues to be tackled by the next generation of GEOHAB, GlobalHAB.

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